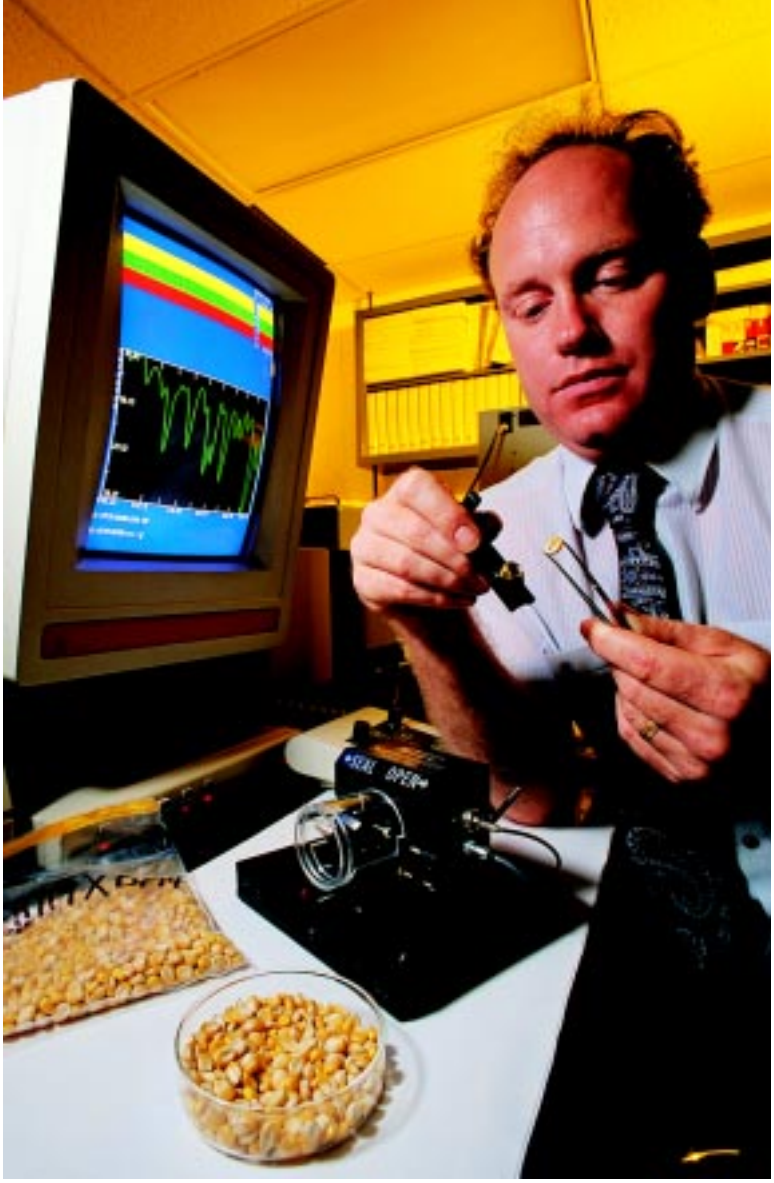
Sound, Infrared Detect Microbes in Grain



KEITH WELLER (K4228-4)

A photoacoustic infrared sensor aids biochemist Richard Greene in screening corn for fungal contaminants.

Corn may not ordinarily sing country ballads. But give kernels a mike, put them under a strobe light, and they'll sound off an earful into scientific instruments.

It's serious listening for Agricultural Research Service scientists concerned about mycotoxins—the metabolic byproducts of fungi like *Aspergillus flavus* and *Fusarium moniliforme*. Mycotoxins pose risks to human and farm animal health.

The sound technology is called Fourier transform infrared photoacoustic spectroscopy (FTIR-PAS). It uses pulses of infrared light to bombard kernels inside a chamber. Resulting heat waves radiate from the corn into the air, creating sound waves picked up by a microphone. Each sound, representing a different infrared wavelength, is recorded in a computer database.

Chemist Sherald H. Gordon says, "Infected and uninfected kernels produce the same tones, but with certain ones, we find subtle volume differences."

To train computers to recognize these differences in infrared patterns, Gordon and chemist Richard V. Greene use software written by University of Illinois computer scientists. Called an artificial neural network, the software distinguishes infected from uninfected corn by using "conditioned reflexes" somewhat like those existing in the human nervous system.

Now, at grain elevators, inspectors routinely check corn for possible *A. flavus* contamination using a bright greenish-yellow fluorescence (BGYF) test. Samples that glow under ultraviolet light are further analyzed in laboratories.

"Our research is aimed at augmenting the BGYF test with an on-line system that would monitor corn moving on a conveyor and divert infected grain from the food and feed supply," says Greene.

At the National Center for Agricultural Utilization Research in Peoria, Illinois, the scientists compared the FTIR-PAS neural network analyses to the BGYF test. BGYF mistakenly gave a clean bill of health to 15 percent of infected kernels, but the neural network erred on only 4 percent.

The scientists look forward to a system that would monitor grain for fungal contamination as it moves through commercial settings.

With colleagues at Iowa State University in Ames, they're also researching the same infrared spectral features using Transient Infrared Emission Spectroscopy, or TIRS. This involves heating kernels with blasts of hot air as they move along a conveyor belt. TIRS measures infrared energy radiating from the grain. Again, healthy and infected kernels emit different infrared patterns.

ARS is seeking an industrial partner to help develop portable infrared sensors paired with a knowledge-based computer program or expert system to enhance reliability of neural networks at elevators and corn processing plants.—By **Ben Hardin,** ARS.

This research is part of New Uses, Quality, and Marketability of Plant Products, an ARS National Program described on the World Wide Web at http://www.nps.ars.usda.gov/programs/cppvs.htm.

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